motion must be altered more fundamentally than has ever before occurred in the history of science.

A clear account of the theory of relativity by Professor William Marshall, of Purdue University, will be found in the MONTHLY for May, 1914. Albert Einstein, then employed in the Swiss patent office, formulated the theory in 1905 with remarkable perfection in a short article entitled "Concerning the electrodynamics of moving bodies." In 1911 he published the paper which deduces the influence of gravity on the propagation of light which is said now to be confirmed by the astronomical observations. Dr. Einstein was appointed to a chair in the Zurich Polytechnic School and was later called to one of the research institutions established in affiliation with the University of Berlin.

The Einstein theory may be said to have had its origin in an effort to explain the experiment on the so-called ether-drift, made by Professors Michelson and Morley somewhat more than thirty years ago at the Western Reserve University. Michelson suggested that the negative result of the experiment could be accounted for by supposing that the apparatus underwent a shortening in the direction of the line of motion. Later Professor Lorenz, the Dutch physicist, assumed that everything gets shortened as it moves through space; that the 8,000 miles of the earth's diameter is shortened up by three or four inches, an amount sufficient to provide a scientific explanation for the failure of the Michelson and Morley attempt to detect that the earth was moving through the ether. Then Einstein proposed his generalization that it is impossible to detect the effects of motion, except when it is relative to another material body, or that it is impossible to detect the absolute velocity of any body through space.

Many queer things have been written and will be written in the daily press concerning the theory of relativity, but perhaps none more strange than the logical deductions from the theory. As an example, Einstein's words (as translated by Professor Wetzel in *Science*, October 3, 1913), in the paper of 1911, may be quoted:

> Give the watch a very large velocity (approximating the velocity of light) so that it travels with uniform speed; after it has gone a long distance give it an impulse in the opposite direction so that it returns to its starting point. We then observe that the hand of this watch during its entire journey to and fro has remained practically at a standstill, while the hand of an exactly similar watch which did not move with respect to the coordinate system (the sun or earth) has changed its position considerably.
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> We must add: what is true for our watch with respect to time must also be true of any other enclosed physical system, whatever its nature, because in all our thinking the watch was introduced simply as a representative of all physical actions or occurrences. Thus, for example, we could substitute for the watch a living organism enclosed in a box. Were it hurled through space like the watch, it would be possible for the organism, after a flight of whatever distance, to return to its starting point practically unchanged, while an exactly similar organism which remained motionless at the starting point might have given place to new generations. For the organism in motion time was but a moment, if its speed approached the velocity of light. This is a necessary consequence of our fundamental assumptions and one which experience imposes on us.

THE DISINTEGRATION OF ATOMS AND ATOMIC ENERGY

THE theory of relativity, though based on physical observations and

mathematical equations, seems to carry us into a metaphysical region remote from our normal interests. The discovery of radio-activity has opened new fields for exploration yielding results almost incredible, but not removed from our ordinary conceptions and everyday interests. At the recent centenary commemoration of James Watt, it was suggested by Sir Oliver Lodge that if Watt were living to-day he would be directing his attention to discovering whether there are other stores of energy at present almost unsuspected. The fact was that contained in the properties of matter there was an immense source of energy so far inaccessible, but which he saw no reason why the progress of discovery should not make available. He referred to atomic energy which, if it could be utilized on an extensive scale, would, he believed, greatly ameliorate the conditions of factory life. There would be no smoke due to imperfect combustion and no dirt due to the transit of coal or ashes, while the power would be very compact and clean. Possibly there might occasionally be explosions due to the liberation of power more quickly than it was wanted, but in general he presumed that the conditions of utilization would be good.

Sir Oliver explained that the secret of this power began to be given away when radio-activity was discovered, and said that at present we were hardly at the beginning of its utilization. The discovery of radium, which soon followed, excited universal interest and aroused great surprise, because radium appeared to give off energy continually without being consumed. The truth was that it did disappear as it gave off its energy, but the disappearance was so slow and the energy given off so remarkable that it was not surprising that one was noticed before the other. The energy of radium, however, was not under control, and it went on emitting energy at its own proper rate without regard to accidental circumstances. What happened was that every now and then a particle was projected. The energy stored in an atom was something enormous, and if we could make the atoms fly off when we wanted there would be available a source of energy which would put everything else into the background. This energy was contained in all forms of matter and was not confined to radio-active substances. If a stimulus could be found the utilization of this source of energy would be possible. We appeared to be on the verge of utilizing a minute fraction of it, and it was this energy which had made wireless telephony possible.

Those familiar with Sir Oliver Lodge's communications with the spirit world may regard his information concerning the energy of atoms as equally speculative, but this is by no means the case. Sir Ernest Rutherford has recently given a lecture before the Royal Institution in which he described experiments which are incontrovertible even though the explanation that he adduces may not be final.

The swift α-particles and the high-speed electrons or β-rays ejected from radio-active bodies are by far the most concentrated sources of energy known to science. The enormous energy of the flying α-particles or helium atom is illustrated by the bright flash of light it produces when it impacts on a crystal of zinc sulphide, and by the dense distribution of ions along its trail through a gas. This great store of energy is due to the rapidity of its motion, which in the case of the α-particle of radium C amounts to

19,000 km. per second, or about 20,000 times the speed of a rifle-bullet. The energy of motion of an ounce of helium moving with the speed of the α-particle is equivalent to 10,000 tons of solid shot projected with a velocity of 1 km. per second.

Sir Ernest Rutherford found from the scintillations on a zinc sulphide screen that when an α-particle strikes an atom of nitrogen the latter is broken down and a long range atom, which is not nitrogen, arises from the collision. This atom is held to be a charged atom of hydrogen or an atom of mass 2. Sir Ernest says that taking into account the great energy of the particle, the close collision of an α-particle with a light atom seems to be the most likely agency to promote its disruption. Considering the enormous intensity of the forces brought into play in such collisions, it is not so much a matter of remark that the nitrogen atom should suffer disintegration as that the α-particle itself escapes disruption. The results, as a whole, suggest that if α-particles, or similar projectiles of still greater energy, were available for experiment, we might expect to break down the nucleus structure of many of the lighter atoms.

INTERNATIONAL SCIENCE AND THE WAR

AN appeal has been addressed to the members of the academies of the allied nations and of the United States by 177 members of the academies of neutral nations—Holland, Norway, Sweden, Denmark, Finland and Switzerland—represented in the International Association of Academies, the opening and concluding paragraphs of which are as follows:

In the autumn of 1813, when for years a most bitter war had been raging between France and England, the English chemist Humphry Davy set out for Italy via Paris. His biographer relates what follows about his experiences in the French capital: "Nothing could exceed the cordiality and warmth of Davy's reception by the French savants. On Nov. 2nd he attended a sitting of the First Class of the Institute and was placed on the right hand of the President, who announced to the meeting that it was honoured by the presence of 'le chevalier Davy.' Each day saw some reception or entertainment in his honour. . . . On Dec. 13th, 1913 he was with practical unanimity elected a corresponding member of the First Class of the Institute."

On October 2, 1918, when a most bitter war raging between France and Germany for four years had practically come to an end, it is stated in a meeting of the French Academié des Science, that "elle a été unanime à déclarer que les relations personnelles sont pour longtemps impossibles entre les savants des pays alliés et ceux des empires centraux," so that "nous devons abandonner les anciennes associations internationales, et en créer de nouvelles entre alliés avec le concours eventuél des neutres."

Whence this painful contrast? We should rather have expected the opposite, even without indulging illusions with regard to the progress of mankind during a hundred years. For there seems to be more room for generosity when the war's misery is past than when it is still raging; more too towards a defeated enemy than towards one who is still to be feared.

. . . . . .

Summing up what precedes we ask you earnestly and urgently: Recover your former selves. Recover the high scientific point of view which, on his deathbed, made Ampère say to a fellow worker: "il ne doit être question entre nous que de ce qui est